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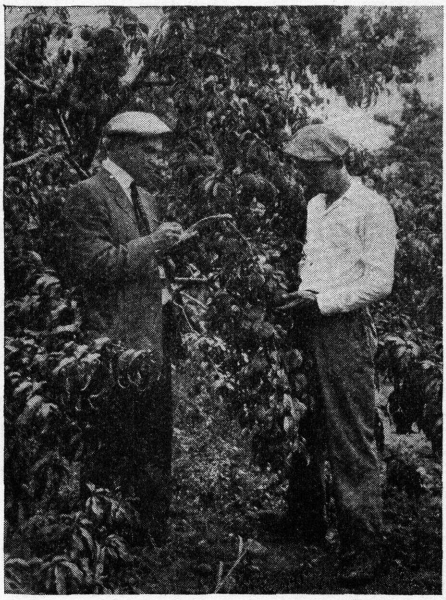
DECIDUOUS-FRUIT IMPROVEMENT *Through* TREE-PERFORMANCE RECORDS



SUCCESSFUL COMMERCIAL production of deciduous fruits is based upon the culture of established, profitable varieties. Systematic individual tree studies of many orchards, particularly those where the trees have just come into bearing, may reveal inferior or off-type trees that reduce profits. These undesirable trees may result from the unintentional propagation of limb variations, from the failure of the buds inserted in the nursery rootstocks, or from accidental mixture of strains or varieties in the nursery. Such trees can be located and their characteristics studied through the individual-tree performance record method described in this bulletin, and if necessary they can be eliminated by replanting or top-working.

Individual-tree performance records are useful in selecting superior trees as sources of bud wood for propagation, in finding valuable limb variations that may give rise to improved strains or varieties, in locating undesirable limb variations to be removed by pruning, in studying the results of orchard practices or experimental tests, and in the systematic care of individual trees.

In deciduous fruit orchards such records are most important as a means for discovering the relations of cultural practices, inherent tree characteristics, and environmental influences to profitable orchard production. It is believed that they will help materially in revealing the causes of failure to obtain satisfactory quantity and commercial quality of fruit and in indicating the best methods of improving yields.

The individual-tree performance records of citrus orchards have been outstandingly useful, both commercially and scientifically. The records have been widely adopted by citrus growers of the Southwest as one of the regular orchard practices. It is believed that a somewhat similar method of individual tree study will prove equally valuable in deciduous fruit orchards.

Washington, D. C. Issued January, 1933

DECIDUOUS-FRUIT IMPROVEMENT THROUGH TREE-PERFORMANCE RECORDS

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TO AN EVER-INCREASING EXTENT, deciduous fruits are produced commercially from comparatively extensive plantings of a few established varieties in orchards that are operated under scientific methods, with systematic attention given to even the smallest details of cultural practices. Every tree should be given individual care in order to raise the average production as high as possible. Some system of recording the performances of individual trees is desirable in order to determine definitely which trees are unproductive or otherwise undesirable. The purpose of keeping individual tree performance records in deciduous-fruit orchards is to obtain definite data on production and other characteristics of individual trees.

VARIATIONS IN DECIDUOUS-FRUIT TREES

Off-type trees occur in most young plantings. In some instances they have been numerous, 2 per cent or more, and have necessitated expensive top-working or replanting. Some come from unintentional mixture of varieties by nurserymen; the rest have usually been accounted for as being caused by buds, inserted in seedling rootstocks failing to grow. Such trees are commonly called seedlings, on the theory that they have actually developed from the seedling stock instead of from the inserted buds.

However, investigations of extensive plantings of young peaches, pears, prunes, and apricots have indicated that in some instances the off-type trees are not seedlings but the results of unintentional propagation of limb variations that occurred on the parent trees from which the bud wood was obtained. The fruit and foliage characteristics of some of these off-type trees resemble very closely those of certain limb variations in trees otherwise normal and indicate that the tree variations probably resulted from accidental propagation of similar limb variations.

Therefore, in the propagation of deciduous fruits, consideration of limb variations becomes highly important. In citrus varieties propagations from the normal branches of trees in which limb variations occur are likely to produce variable progenies. Some of these progenies will bear varying quantities of fruit like that of the limb variations in the parent trees, and others will produce only the

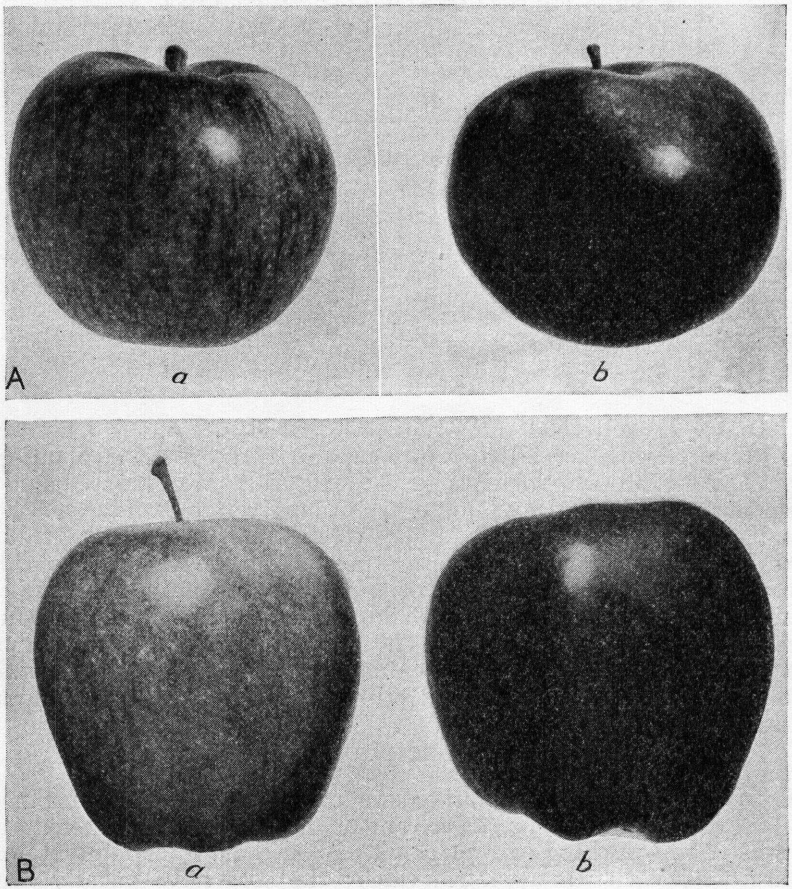

FIGURE 1.—A, McIntosh apples from tree at Fennville, Mich.: *a*, Normal fruit; *b*, solid red fruit borne on limb variation. B, Delicious apples from tree at Wenatchee, Wash.: *a*, Normal fruit; *b*, solid red fruit borne on limb variation

abnormal type of fruit. It seems probable that this is also true of deciduous fruits and explains the origin of some of the off-type trees.

CLASSIFICATION OF VARIATIONS

Variations may be classified as: (1) Fluctuations, which are not stable but are probably caused by climate, soil, cultural practices, or some other environmental influences; and (2) true variations, which may consist of a branch, limb, or an entire tree. These latter are not caused by environmental conditions and may be perpetuated by budding. They are called "bud variations" and in those most com-

monly observed the characteristics of the fruits or foliage offer striking contrasts to the normal.

Bud variations may, from the grower's standpoint, be superior or supplementary to the true or normal variety, or they may be inferior. The red strains of the Delicious and certain other apple varieties, for example, originated as bud variations; their earlier, more uniform, or deeper color makes many of them more desirable than the normal-type fruits of these varieties. Fruits of red strains of the McIntosh, Delicious, Jonathan, and Winesap apples, which originated as limb variations, are shown in Figures 1 and 2. Inferior

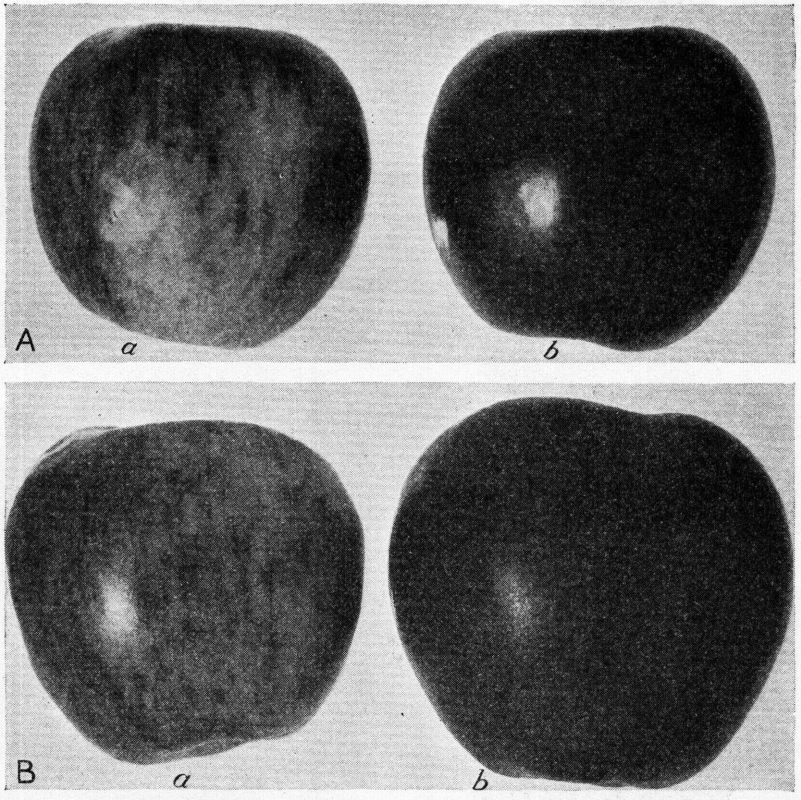

FIGURE 2.—A, Jonathan apples from tree at Wenatchee, Wash.: *a*, Normal fruit; *b*, solid red fruit borne on limb variation. B, Winesap apples from tree at Wenatchee, Wash.: *a*, Normal fruit; *b*, solid red fruit borne on limb variation

variations may cause loss in grade and quality, and increased cost of sorting and packing. Continuing to propagate them unintentionally may produce large and increasing numbers of off-type trees in the variety.

A bud variation of a Sims peach tree near Merced, Calif., and the progeny trees propagated from it, bear peaches that mature about two weeks earlier than those borne by comparable normal Sims trees. This early maturity extends the harvesting season and the variation is a valuable supplementary strain. Figure 3 shows fruits from both the normal part of the tree and the variation.

An unproductive bud variation occurred on an otherwise normal Tuskena (Tuscan) peach tree in the same orchard, and the progeny trees propagated from it are almost entirely barren. This unproductive strain, wholly worthless for commercial culture, is an example of an undesirable strain originating from a bud variation.

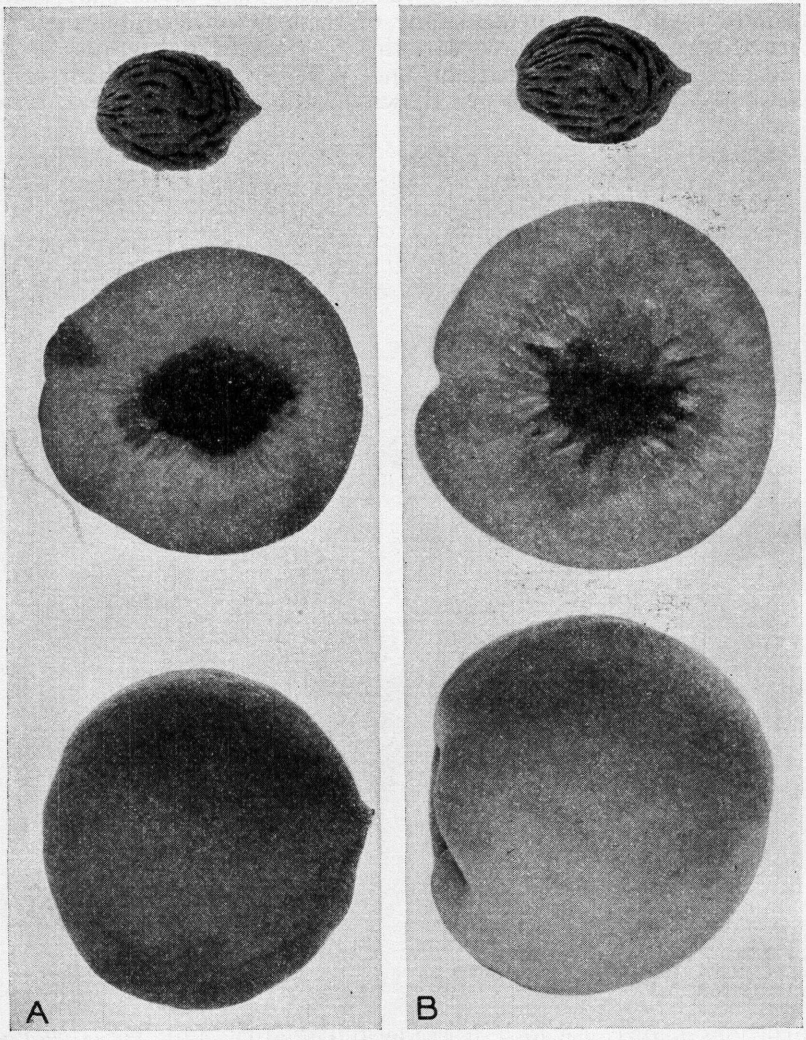

FIGURE 3.—A, Normal Sims peaches, still immature; B, mature Sims peaches that have ripened two weeks earlier than the normal (A), borne on a limb variation of the same tree. Merced, Calif.

Figure 4 shows a typical fruit from a desirable peach limb variation and one from an undesirable limb variation on another tree of the same variety. Progeny tests have proved both to be true variations.

Of the bud variations found in deciduous fruits, those occurring as limbs and known as "limb variations" have been most conspicu-

ous. Individual-tree studies in an extensive orchard in central California, planted largely to a few established canning-peach varieties, have revealed 39 striking peach limb variations with the following outstanding characteristics: Fruits ripening earlier or later than those on the normal part of the tree (fig. 5); abnormal size, shape, color, or texture of fruits; abnormal size, shape, or quantity of leaves (fig. 6); and abnormal forms of vegetative growth. Progeny propagations have perpetuated the late-ripening character of the limb variation shown in Figure 5 and the abnormal leaves of the one shown in Figure 6. Such conspicuous variation from the normal had passed unnoticed because of unfamiliarity with the characteristics and significance of limb variations, and lack of knowledge as to when, where, and how to look for them. For the same reasons equally apparent limb variations have not been noticed more frequently in other deciduous orchards.

In the Wenatchee, Wash., district where several bud variations of the standard apple varieties are being grown commercially to an

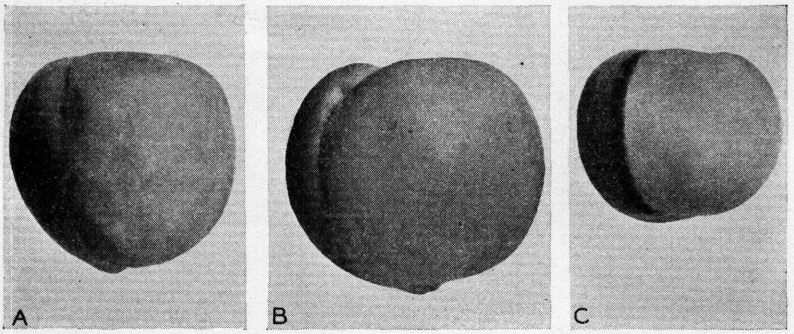

FIGURE 4.—Fruits from Ontario peach trees: A, Normal fruit; B, fruit borne on a limb variation, on same tree as A, that is apparently identical with that of the Peak variety; C, fruit with a deep-red keel instead of the normal suture, from a limb variation in another tree. West Riverside and Ontario, Calif.

increasing extent, over 50 such variations are now under observation and test. Many other bud variations of apple varieties have been discovered and are being tested or grown commercially in Michigan, Massachusetts, New Jersey, New York, Virginia, and, in fact, in most of the important apple-producing sections. Growers, orchard workers, and others interested in apple growing are becoming familiar with the occurrence of bud variations showing differences in color, size, and other characters and are constantly on the alert during the fruiting season to discover new ones that may be of commercial value after being isolated and propagated as improved strains.

In a number of limb variations in peach, prune, and apricot trees the shape, size, and number of leaves are very different from those of the normal foliage borne by other limbs of the same tree. Limbs of peach, apricot, pear, and prune trees that bore variegated leaves or leaves with light-colored areas, have also been discovered and some have been propagated through buddings. They are of scientific interest and of possible commercial importance.

SEARCHING FOR BUD VARIATIONS

Early-maturing limb variations are most apparent two or three weeks before the normal fruits ripen, and when the color indicating maturity of the early fruits is in sharp contrast to the green of the

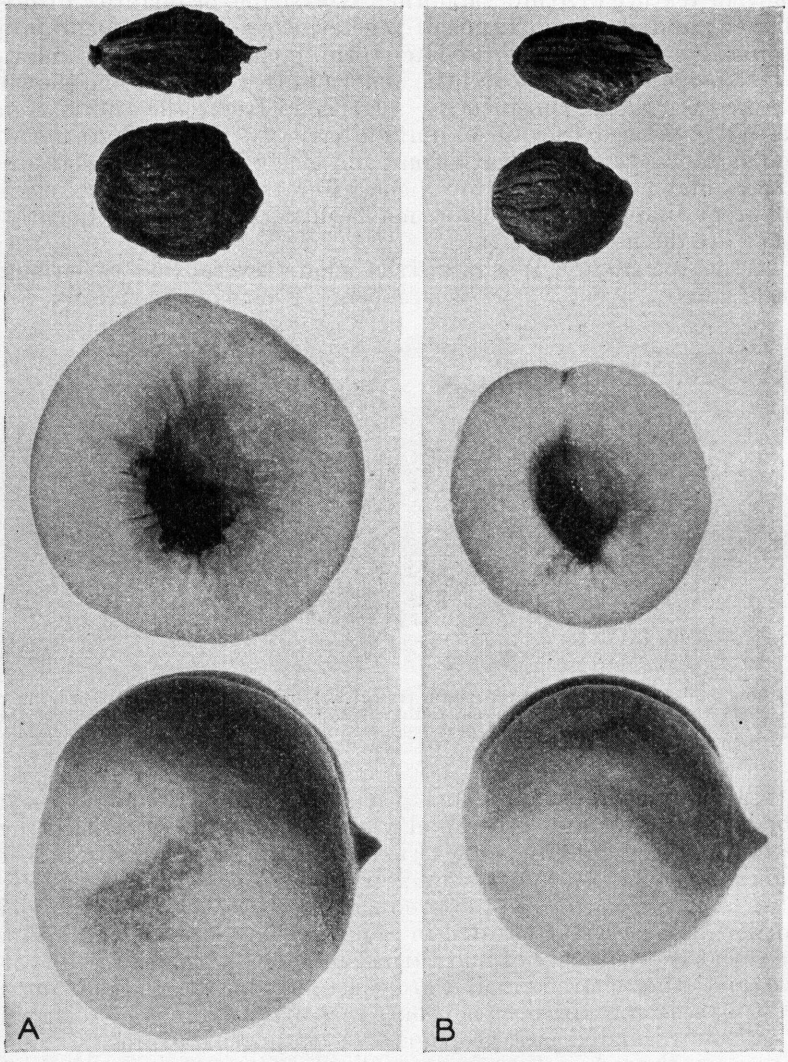

FIGURE 5.—A, Mature, normal fruits and seeds from Phillips Cling peach tree; B, immature fruits and seeds from a limb variation of the same tree. Merced, Calif.

immature, normal fruits. Such limbs or trees should be marked, their location in the orchard, the date of discovery, the apparent difference between the time of maturity of the fruits borne by the variation and that of the normal fruits, and any other descriptive matter should be recorded.

Late-maturing limbs, entire trees, or individual fruits that are noticed at the normal time of harvest of the crop should be marked, their location recorded, and their characteristics described. The writers found several striking late-ripening limb variations by inspecting peach trees after the main crop had been picked.

Russeted-pear and other deciduous-fruit limb variations are most apparent when the fruits are approaching maturity. Large-fruited Bartlett pear and Winesap apple limb variations and others showing abnormal size or shape of fruits or peel texture are most apparent about the time the fruits are fully mature and just before harvest. In Figure 7 are shown russeted, corrugated, and other abnormal pears produced on limb variations.

Figure 8 shows a large-fruited Agen (French) prune from a limb variation similar to one from which a new variety originated.

The quantity of fruit per tree is, of course, observable over a considerable period, but is best studied about the time of harvest. The commercial qualities of the fruits are most conveniently studied just before or during harvest. However, the search for sporting limbs in otherwise normal fruiting trees or for entire tree variations is, on the whole, most efficient during a period of from two to three weeks before the actual harvest is begun.

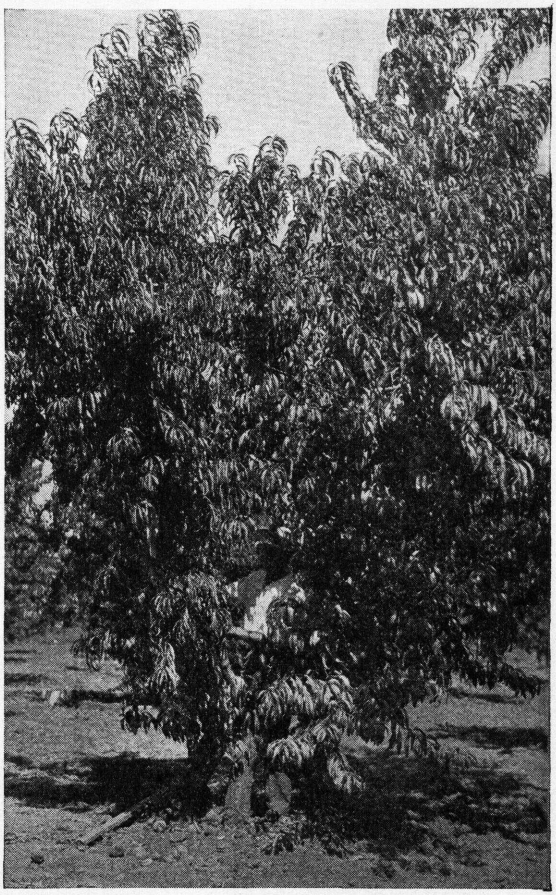

FIGURE 6.—Lovell peach tree with a limb variation (left) having long, very narrow, glandless leaves. Merced, Calif.

OBTAINING INDIVIDUAL-TREE RECORDS

The work of obtaining individual-tree records is much simpler if carefully planned before the harvest. Experience has shown that in some instances it is best for the grower to study only a small block of trees in the beginning in order that he may become familiar with

the methods of study. An increasing number of trees may be observed during later years.

INDIVIDUAL-TREE NUMBERS

In order to identify any considerable number of individual trees with certainty, year after year, some method of numbering and

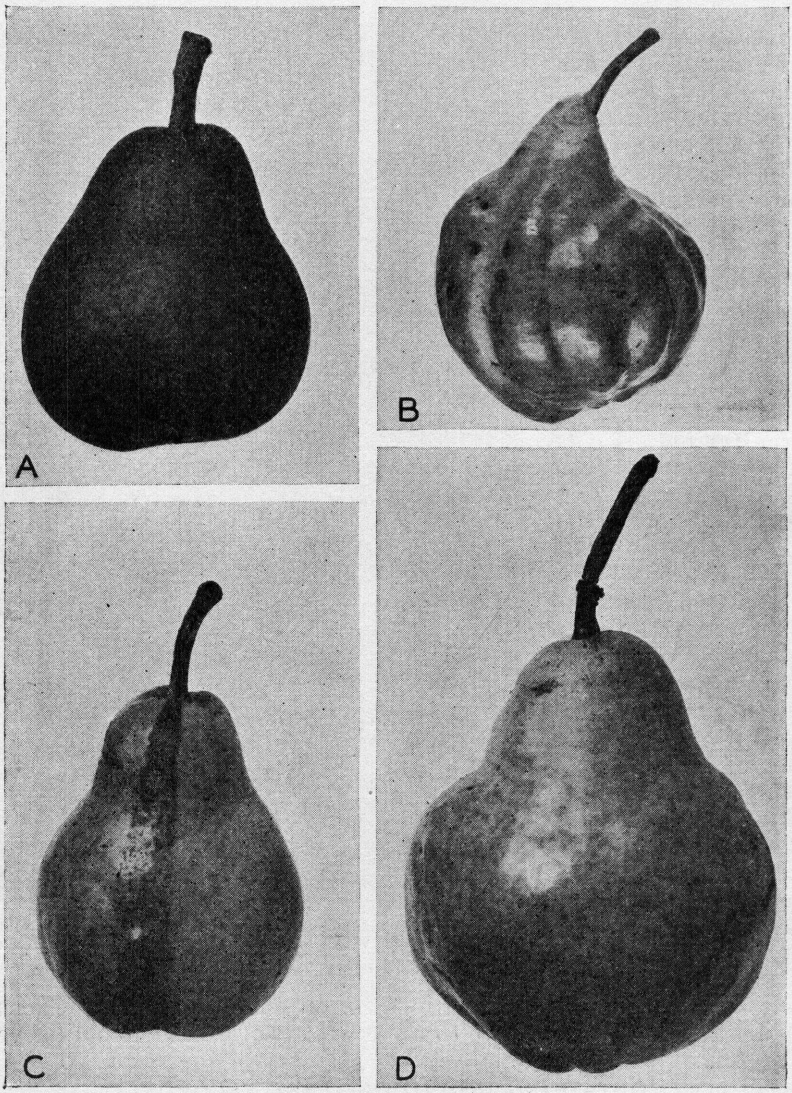

FIGURE 7.—Fruits from limb variations in a 40-year-old orchard of Bartlett pears: A, Heavily russeted; B, corrugated; C, russeted section; D, collared. Santa Clara, Calif.

marking them is necessary. Such a plan assigns to each tree a combination number consisting of the number of the orchard block or section, the number of the tree row in the block, and the number of

the tree in the row, always counting from some fixed point. For example, the number of tree 20 in row 18 of orchard block 14 will be 14–18–20. In small orchards the individual-tree number may include only the tree and row numbers.

The numbers may be painted in vertical columns on the trunks of the larger trees, as shown in Figure 9. The trunks should be brushed before the figures are painted, and the figures should be on the same side of all trunks in order to be found conveniently. Pure white-lead paint, applied with a lettering brush, is used. The numbers must be clear and large enough to be easily read from several feet away. After a little experience a workman, under ordinary conditions, can paint numbers on 175 trees a day. He should have a list

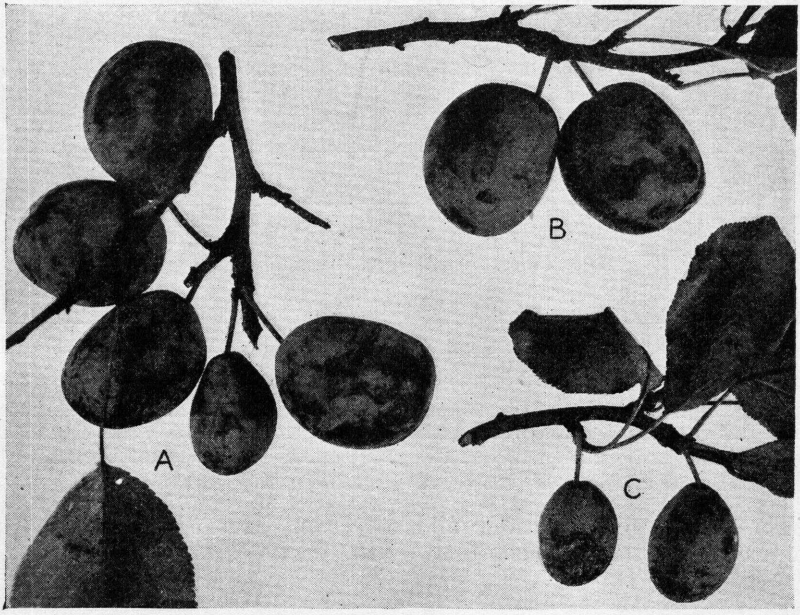

FIGURE 8.—Variations from a single Agen (French) prune tree: A, Bud variations; B, large-fruited limb variation similar to that from which a superior strain of fruit has been established by selection and propagation; C, normal fruit. Morgan Hill, Calif.

of the numbers for each row and his work should be inspected frequently for correctness.

On very young trees with trunks so small that it is impracticable to paint the figures on them, the numbers are often printed on wooden labels or stamped on metal tags, which are so attached to the trees as not to interfere with their growth. Numbers on slightly larger trees, with trunks too small for the usual arrangement are sometimes arranged in a vertical column, one digit below another, the orchard block and the row and individual-tree figures being separated by horizontal lines. If the trunks are whitewashed or otherwise coated it will be necessary either to protect the figures or to use the labels suggested for very small trees.

If it is impracticable to paint tree numbers on all trees, the first and last and the fifth or tenth tree in each row may be numbered,

but this is only slightly less expensive than painting numbers on all trees. The figures may become slightly distorted with the growth of the trunks, but they will ordinarily remain legible for several years, long enough for obtaining adequate data on individual-tree performances.

A map of the orchard, showing the tree numbers in the same relative positions as the trees in the planting, should be made to provide a permanent record of the arrangement and number of the trees.

RECORD FORMS

A printed loose-leaf form is useful for recording the performance data, though the grower may rule an ordinary notebook for this purpose. The form used by the writers is shown in Form A. It is printed on sheets 4 by 6 inches in size.

FORM A.—*Form for recording individual-tree performances in a field notebook*

LOCATION_____ BLOCK_____
VARIETY_____ ORCHARD_____ ROW_____

Tree No.	Fruit				Tree			Notes
	Crop		Size	Ripe	Size	Type	Glands[1]	
	Quantity	Per cent						

RECORDS BY_____ DATE_____

[1] The column marked "glands" is useful only on forms for records on peach trees.

The following definitions and directions are printed inside the front cover of the notebook used by the writers:

EXPLANATIONS OF TERMS AND SYMBOLS

TREE NO.—Record the tree numbers in use by the grower wherever possible; otherwise, explain in detail the system adopted and illustrate it with a diagram showing the arrangement of the orchard block and the method of numbering.

FRUIT:

Crop.—Record in the first column the estimated crop in number of boxes, pounds, or fruits, and indicate the unit used. In the second column record the estimated percentage of a maximum crop, taking into account the size and condition of the tree.

Size.—L=large size for the variety, S=small. Normal size need not be recorded.

Ripe.—Refers to the time of ripening as compared with the normal for the variety. E=early, L=late. Normal ripening need not be recorded.

TREE:

Size.—Refers to comparative size of trees in the block being studied. L=large, S=small. Normal size need not be recorded.

Type.—P=productive, P*=outstandingly productive, U=unproductive. Normal production need not be recorded.

GLANDS.—For use in peach variety studies. O=glandless, G=globose, R=reniform.

NOTES.—Record briefly any characteristic or condition of tree or fruit which may help explain the performance of the individual tree, such as disease, insect injury, broken limbs, striking variations of foliage or fruit, cultural treatment, pruning, replants, top-worked trees, or other phases of tree development.

FIELD RECORDS

Fruit from each tree may be picked and actually weighed, counted, or measured, or it may be estimated in terms of weight, number of fruits, number of containers, or the percentage of a theoretically full crop with age, size, and habit of growth of the tree taken into account. Factors such as kind of fruit, number and frequency of pickings, length of picking season, and availability of trained labor and supervision will determine whether the yield is actually measured or estimated. Actual measurement is desirable in experimental studies, but careful estimates are satisfactory for commercial orchardists.

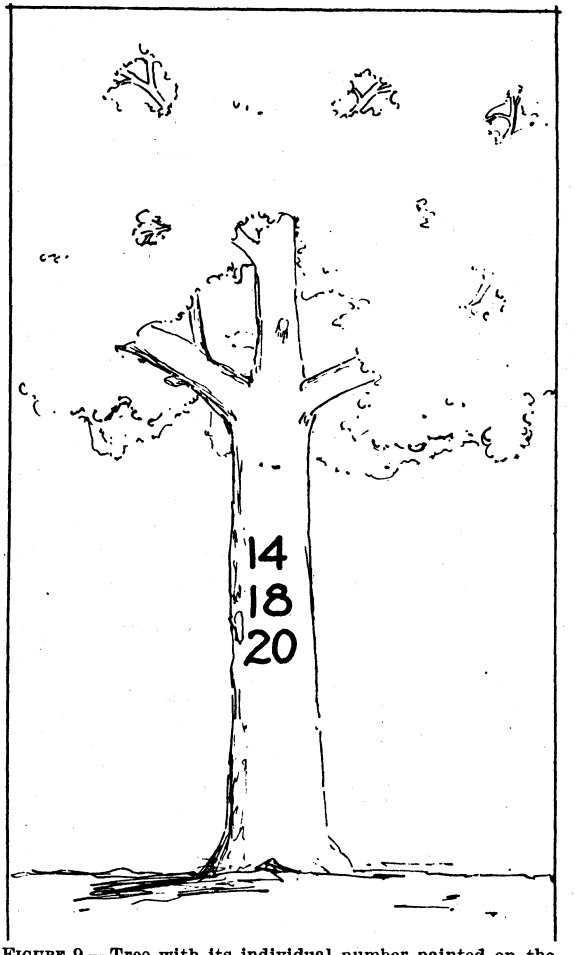

FIGURE 9.—Tree with its individual number painted on the trunk

Notes on abnormal blossoming dates, peculiar bloom characteristics, pruning, thinning, spraying, frost or wind injuries, and other tree conditions are helpful in interpreting results and may be kept in the field notebooks.

Pickers and other employees, if told what to look for and how to look for it, can give valuable aid in discovering desirable bud variations by noticing striking foliage or fruit differences.

To obtain actual-yield records it is necessary to pick each tree separately and to record the quantity of fruit harvested from each tree at each picking. With the proper distribution of boxes and with trained labor, one recorder can keep up with a large number of pickers and can also record any unusual fruit or tree condition.

If the yield is recorded in terms of boxes or other fruit containers, a few filled containers should be weighed so that the records can be translated into terms of weight if desired. Partly filled containers should be weighed or the quantity of fruit in each estimated. Ordinarily, estimates to quarters of the recorded unit are sufficiently accurate.

For records of actual yields in some commercial orchards growers securely tie a strong paper tag about 3 by 6 inches to a branch on the same side and at about the same height on each tree. A form is usually printed on the tags with spaces for the name or number of the orchard, the individual-tree number, and for yields at several pickings. After each picking the yields should be copied from the tags into a notebook to prevent losing any of the data.

Persons not trained in estimating the yields of fruit trees should, at first, frequently check their estimates with actual picking records.

Yield records are of increasing value when the work is carried on for several consecutive seasons, and it is desirable to have the same person make the estimate for each block of trees each year. The estimated quantity of fruit, and, if desired, the percentage of a full crop should be recorded, and notes made of any outstanding or abnormal characteristics, such as the size and degree of ripeness of the fruits and the size, type of growth, and other characteristics of the trees. To avoid unnecessary note making, only conditions and characteristics markedly different from the normal are recorded.

The tree-estimate records should be obtained shortly before the fruits are picked. At this time it is possible to judge the size, color, and shape of fruits, as well as the approximate quantity. Some satisfactory estimate records have been made a week or 10 days before picking, but, as a rule, these data have been obtained 2 or 3 days before the commercial harvest.

PERFORMANCE-RECORD PERIODS

Performance records covering the early years of full bearing are considered most valuable in locating undesirable trees. Undesirable trees can be top-worked or replanted with a minimum loss of time and with the least expense in early years.

To guide the selection of good-type trees as sources of bud wood for propagation, records for two consecutive years of normal full bearing are usually sufficient, but records covering four years are preferable. In comparing the results of cultural practices, the length of the performance-record period may be adapted to the individual conditions, in order to obtain adequate and reliable data. The ideal performance-record period covers the productive life of the trees.

ASSEMBLING DATA FROM FIELD RECORDS

The data from the field notebooks may be transferred to office forms, preferably loose-leaf type, on which the records for each tree for a period of years are brought together. The office form used by the writers is shown in Form B.[1]

[1] For economy of space, Form B as here reproduced is somewhat abridged as to number of trees. In actual use the form occupies a full sheet 8 by 10½ inches and allows space for records of four trees (instead of one) for eight years each.

FORM B.—*Loose-leaf form for assembling individual-tree performance records for a series of years*

TREE-PERFORMANCE RECORDS

LOCATION_____ GROWER_____ BLOCK_____
VARIETY_____ ORCHARD_____ ROW_____

Tree No.	Year	Fruit				Tree			Notes
		Crop		Size	Ripe	Size	Type	Glands	
		Quantity	Per cent						

In order to interpret the tree records intelligently it is desirable to assemble them in tables or charts on which the yearly crops and the total yields for the performance-record period can easily be compared and crop variations studied in connection with the relative positions of the trees in the orchards. Charts showing the distribution of trees with comparatively high, average, or low yields are helpful. An annual distribution chart will be interesting and instructive to the grower, but a chart showing the distribution of the average yields for a period of several seasons will indicate the relative values of the different trees.

A simple method of thus comparing individual-tree yields is illustrated in Table 1, which shows the estimated individual-tree yields in a block of Lovell peaches, expressed as percentages of a full crop for 1926. These trees were seriously affected by abnormal weather conditions during the preceding winter. On the south side of the block is a high windbreak. Relatively high yields from trees just north of the windbreak are shown in Table 1. They indicate that production in this part of the block was increased by the protection of the windbreak. Further investigation indicated that this protection consisted largely of shading the trees from the sun during hot days in the winter.

Recording the percentage of a full crop, as well as the actual yield, has the advantage of showing the production of the trees irrespective of their age and size, and without referring to other records. For instance, when charted on the basis of actual yield, a young tree in an older orchard would show a small crop among heavier yields and would thus appear to be a poor tree, whereas if the yields were shown as percentages of a full crop the normal young tree would be indicated as comparable to the older ones. The method of charting any particular orchard will depend largely upon the purpose of the record.

TABLE 1.—*Individual-tree production for 1926 in 10 rows of a block of Lovell peaches, Cucamonga, Calif., expressed as percentages of a full crop*

[Each figure indicates the percentage of a full crop borne by one tree. Beyond tree 24 of each row this orchard was bordered by a double-row planting of tall Eucalyptus trees]

Tree No.	Row No.—									
	50	51	52	53	54	55	56	57	58	59
1	½	1	0	0	1	0	½	0	2	1
2	2	1	0	0	2	1	0	0	2	4
3	¼	1	0	2	R.	0	2	1	½	3
4	1	4	0	0	2	1	3	1	1	5
5	4	20	4	5	1	½	5	1	2	1
6	1	1	1	10	4	8	2	2	3	3
7	2	1	3	5	8	1	0	2	1	½
8	1	10	0	0	4	1	R.	0	4	3
9	1	8	2	3	D.	6	0	0	2	1
10	2	1	3	10	8	S.	1	0	1	3
11	2	5	3	4	—	3	0	4	4	8
12	1	15	2	2	½	1	2	2	0	2
13	6	40	1	3	1	3	2	2	1	5
14	1	3	12	5	1	12	1	1	8	4
15	1	4	0	0	5	2	0	2	2	2
16	3	5	3	5	2	4	0	2	5	3
17	4	R.	2	10	1	6	1	10	10	5
18	20	30	10	1	15	5	5	5	15	30
19	25	35	10	2	20	25	10	20	15	25
20	60	50	25	40	40	35	30	R.	30	30
21	75	90	66	66	75	80	66	75	75	80
22	80	75	75	75	85	90	66	66	60	75
23	90	85	66	60	90	85	40	85	70	60
24	50	75	—	—	25	75	—	—	—	50

N

0 indicates no crop.
R. indicates a replanted tree.
S. indicates a seedling tree.
D. indicates a diseased tree.
— indicates no tree.

One plan of charting individual-tree performance records is to select different colors for trees with high, medium, and low yields, and to color the squares on the chart according to the amounts or percentages of yield shown by the trees in that square. Superior trees may be designated by some special symbol.

Different symbols may be used, like different colors, to indicate various classes of yields, and the appropriate symbols placed on the chart to mark the relative locations of the trees whose yields they indicate. Trees may be divided into classes according to whether they are unprofitable, barely pay for their maintenance, or are profitable. Superior trees suitable as sources of bud wood for propagation may be identified by special symbols on the chart, as may other trees that require replacing, top-working, or other care.

Actual yields may be recorded in figures on the chart at the relative positions of the trees to which the figures apply. Different colors of ink and different symbols can indicate diseased or injured trees, poor trees that are to be replaced or top-worked, and superior trees suitable as sources of bud wood.

USING INDIVIDUAL-TREE RECORDS

The data on individual-tree performances may be used (1) in locating superior strains for commercial use; (2) in locating unprofitable trees that need top-working or replanting; (3) in making progeny tests of selected parent trees; (4) as the basis for systematic care of individual trees; (5) in comparing the results of different cultural

practices; and (6) in establishing reliable sources of propagating material.

ISOLATING AND PROPAGATING SUPERIOR STRAINS

In order to maintain the fruit-producing efficiency of an established fruit variety it is advisable to propagate the variety commercially with bud wood only from trees of good type. After such trees have been identified by their performance records they should be carefully studied in the orchard before the next crop is picked, and outstanding trees that by reason of their fruit and vegetative characteristics seem best suited for propagation should be selected. Through systematic selection of the best trees as sources of bud wood, further propagation of undesirable strains can be largely eliminated.

Striking limb or entire-tree variations should be carefully observed and their blossoming and fruiting characteristics systematically studied for two or three years. If they are found to be of possible commercial value, progeny propagations from them should be made in order to determine the performance of the progeny in the orchard, particularly its inherent stability. From the results of the experimental progeny tests, conclusions on the desirability of making commercial orchard tests of the promising variations can be drawn.

LOCATING UNPROFITABLE TREES

Trees that are healthy, yet shown by their performance records to be consistently low yielding and unprofitable, may be top-worked or replaced. Individual factors will determine which process to use. Top-worked trees should receive individual care for several years after the operation, to make sure that new growth develops solely from the bud wood and is so pruned as to develop strong and well-balanced tops. In replanting in mature orchards it is advisable to plow or dig ditches entirely around the young trees and fill the ditches with manure or other fertilizer to stimulate growth of the young trees and lessen competition with the larger root systems of older neighboring trees.

MAKING PROGENY TESTS OF SELECTED PARENT TREES

Progeny tests are recommended for obtaining definite evidence on the transmissibility of important tree characters discovered in the course of the individual-tree record work. These tests can be made either by top-working established trees or by budding nursery seedlings. Top-working gives quicker results than budding, but it is often impracticable to obtain satisfactory trees for top-working. Nursery budding, therefore, is ordinarily the more practical method.

In propagating selected parent trees, all bud sticks from each tree may be given the parent-tree number. If propagations are being made from a number of different orchards, the records can be simplified by establishing a new series of propagation numbers, and then making a key list showing the parent tree represented by each number on the new list, the date it was propagated, and other related information.

When the progeny trees begin production their individual-tree yields may be kept for a period of years in order to determine the

inherent stability of the progenies and their relative value for commercial use. Only the best progeny trees should be chosen for further propagation.

In making progeny tests of striking limb variations, bud wood should be taken from the variation and from a normal branch of the same parent tree and numbered with distinctive modifications of the parent-tree numbers. If the parent tree number is 3–21–6, bud wood from the normal limb may be 3–21–6A and that from the limb sport 3–21–6B. More than one limb sport from the same parent tree may be identified by different letters. If many limb-sport propagations are to be made a new system of numbering the progeny may be adopted, as 1A and 1B, 2A and 2B, for normal and variable forms, respectively, from each tree, and a key list made describing the various characters of the propagations.

COMPARING CULTURAL PRACTICES

Tabulating individual-tree yields in an orchard block may reveal areas of light production caused by differences in soil types or earlier soil treatments. Plotting the yields of one orchard showed an area of low yields near the center of the block. The low yields were found to have been caused by the removal of the surface soil in grading for irrigation before the orchard was planted. These trees were brought up to normal production by resurfacing the area with top soil from outside the orchard. It was also found that low yields of trees near the irrigation flume and at the lower ends of the rows were caused by poor soil conditions and were improved by correcting these conditions.

Performance records will show definitely the behavior of trees that have been treated for disease or insect infestation and will indicate the proper ultimate disposal for them.

The death of trees often causes considerable loss, and in close plantings it is sometimes difficult to decide whether it is profitable to replant the vacant spaces. Individual-tree records make it possible to compare the production of trees near the vacant spaces with that of trees in solidly planted areas, and to determine the advisability of replanting.

It is sometimes wise to try out fertilizer treatments on small plots before adopting them for general orchard use. Individual-tree performance records are of great assistance in interpreting results of such tests.

The relation between production of individual trees and the length of the irrigation run can be ascertained from individual-tree records. Effects of different methods of pruning and different degrees of severity of pruning will also be shown by such data. The effects of different kinds of cultivation, of different varieties of cover crops, and of many other factors can also be compared through a study of performance-record data.

Abnormal limbs in otherwise normal trees sometimes reduce the production of the trees or add to the expense of sorting the fruit. Through individual-tree performance records such limbs can be found and their characteristics determined so that they can be pruned out if proved undesirable.

ESTABLISHING RELIABLE COMMERCIAL SOURCES OF PROPAGATING MATERIAL

In studies of citrus varieties systematic individual-tree performance records have been a practical and successful guide in selecting superior trees as sources of propagating material. Investigations in deciduous orchards from 1921 to 1931 indicate that similar records will give reliable guidance in propagating deciduous-fruit trees.

Study of individual-tree records as guides in bud selection includes: (1) A comparison of the quantity and quality of fruit produced over a period of years; (2) a study of the environment of any particular tree in relation to its productivity; and (3) careful observation of the relative uniformity of the type of fruits borne by the trees. As a result of these studies it should be possible to select those trees that have been the most consistent in producing high yields of uniformly good fruits. Other less definable considerations enter into the selection of superior parent trees, particularly the experience of intimate tree knowledge gained in securing and assembling the records. With such experience comes greater facility in studying variations and selecting superior individual trees.

Cooperative or other organizations of deciduous-fruit growers can aid individual orchardists by procuring and supplying selected buds. The success of deciduous-fruit industries depends in part upon the quantity per acre and the commercial quality of the fruit to be marketed, and propagating good-type trees of the different varieties is a fundamental factor, since the individual tree is the unit of production.

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U. S. GOVERNMENT PRINTING OFFICE: 1933

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